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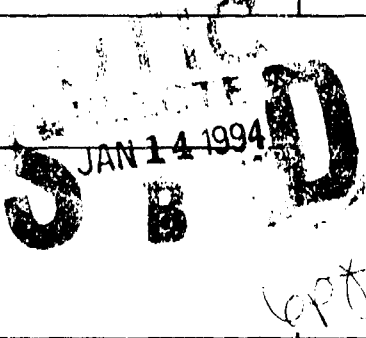



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13 ABSTRACT (Maximum 200 words) <p>We have been working at the NCCOSC RDT&E Division (NRaD) to develop new methods of assisting Navy decision makers in real time command and control decision-making situations. Our work has focused directly on the incorporation of new kinds of knowledge based computer tools into shipboard decision support systems. As part of that work, we have had the opportunity to examine various approaches to influencing human decision makers through interface manipulations. The general conclusion we have reached is that interfaces used by expert decision makers in real time situations should make only limited use of techniques such as direct manipulation that require users to interact with the system. It follows that efforts to provide a critiquing mechanism should emphasize critics that operate automatically without waiting for the user to request assistance. However, we are also looking for an interface that does not automatically change displays in ways that users may find intrusive, or otherwise objectionable. To address both having automatic criticism and non-intrusive display changes, we are looking for ways to provide critiquing that is transparent to the user.</p> <p>This paper describes ideas about appropriate ways to make use of ideas from work involving critics.</p> <p>Published in <i>Proceedings of the 10th Annual Conference on Command and Control Decision Aids</i>, July 1993.</p>					
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User Interface Issues in Real Time Decision Support Systems

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Introduction.

We have been working at the NCCOSC RDT&E Division (NRaD) to develop new methods of assisting Navy decision makers in real time command and control decision-making situations. Our work has focused directly on the incorporation of new kinds of knowledge based computer tools into shipboard decision support systems. As part of that work, we have had the opportunity to examine various approaches to influencing human decision makers through interface manipulations. The general conclusion we have reached is that interfaces used by expert decision makers in real time situations should make only limited use of techniques such as direct manipulation that require users to interact with the system. It follows that efforts to provide a critiquing mechanism should emphasize critics that operate automatically without waiting for the user to request assistance. However, we are also looking for an interface that does not automatically change displays in ways that users may find intrusive, or otherwise objectionable. To address both having automatic criticism and nonintrusive display changes, we are trying to find ways to provide some critiquing in a way that is transparent to the user.

Underlying Problems.

The research at NRaD is focused on the testing of new ideas about the use of knowledge based decision aids in tactical situations where decisions must be made under severe time constraints, based on incomplete or ambiguous information. This work is funded by the Office of Naval Technology under a project called TActical Decision Making Under Stress (TADMUS).

The primary goals of the research are to seek solutions to the following problems. First, there is the problem of trying to find ways to remedy human errors. Research indicates that human decision makers sometimes make decision errors as a result of one or more cognitive biases (Kahneman & Tversky, 1982). However, there has been little done to test approaches to providing remedies for such errors. Our effort is aimed at trying to provide a remedy through the use of knowledge based computer tools. Other work in the TADMUS project is looking into new ideas in training as a remedy.

A second problem is to develop tools that can be accepted by the users. This problem is more serious in our situation than in other areas involving the

use of knowledge based technology, because in our case decisions will often have life and death consequences. It is essential, then, that users fully understand what the decision support system can do for them, as well as what the system cannot do. These are situations in which it is definitely not believed to be desirable for users to have the impression that the computer can make the final decisions on its own.

A third problem lies in determining how best to present information to the users. It is not enough to produce tools that can provide critical kinds of information to users. That information must be structured in ways that make it readily accessible. Moreover, in a real time setting it is important to minimize the degree to which the tool itself may become intrusive in ways that can degrade performance.

Decision-making strategies.

Initial research for TADMUS was aimed at identifying decision-making strategies used by expert Navy decision makers. That research has pointed to the use of two primary naturalistic decision-making strategies: recognition primed decision making (RPD) (Klein, 1989) and explanation based decision making (Pennington & Hastie, 1988).

Based on the finding that those two strategies are predominant, two decision support tools have been prototyped that try to model the strategies. One tool uses a template based approach to model the RPD idea that most expert decision making is based on matching the features of the current situation to features of prior, stored, situation templates. The other tool is called SABER (Situation Assessment By Explanation based Reasoning), and it models the explanation based decision making strategy in which explanations are constructed to account for available information, and decisions are based on a determination of the degree of plausibility of the explanations (Hair et al, 1992).

The hypothesis behind constructing tools that model the user's own decision making strategies is that the use of those strategies should enable the tools to provide the kind of information that will be most useful to the user, in a way that will be readily comprehensible. Tied into that idea is the belief that the decision support system should be able to suggest to the user where errors could arise, or could guide the user away from making errors. This latter kind of information is in the nature of offering suggestions, but is kept indirect both so it will not be intrusive in the real time situation and so it will not be seen as a case of the computer trying to make the decisions. Part of our hypothesis is that some cognitive biases may be remediable through such devices as always presenting the user with alternative explanations, and highlighting for the user where the weaknesses are in the explanations.

Integrating the tools into a decision support system.

Having developed tools that model key decision making strategies, the problem remains of developing an interface to exploit the use of those

models. In the setting of Navy command and control operations, the real time nature of the problem ends up driving a number of decisions regarding the interface.

The emphasis on real time operations has led to a general elimination of features that require interaction with the user. That elimination leads to a severe simplification of tool capabilities from the original prototypes. Those prototypes had made considerable use of a variety of direct manipulation techniques that appear impractical for the final real time system because they cause a loss of time in situations where time is at a premium. A direct conclusion resulting from the real time consideration is that the interface needs to provide information concisely, and preferably automatically. However, pulling against that approach is the need to be able to let users have some ability to select different information displays according to their own belief as to what is most useful for them to see at any given time. In addition, the limited availability of screen space leads to the need to provide for some user driven mechanisms for changing the displays.

Use of critics in this setting.

One general approach to enhancing user performance is to provide the user with some form of criticism of the user's ongoing decision making processes. A critic facility could attempt to focus the user's attention on data that might be overlooked due to cognitive biases. It could also highlight alternative analyses as a way of keeping the user aware of the fact that in ambiguous situations different analyses should be considered.

One suggested approach has been to incorporate an extensive model of the user within the system. The idea is that such a model can enable the system to form a judgement based on current user actions as to what the user's cognitive focus is. The system can then determine what kinds of information can most usefully be displayed at that time. This kind of system would act as a critic in the sense that it would be making judgements as to what the user ought to be doing, and would provide information intended to guide the user to doing such.

We believe that approach merits further study, but are not pursuing it in the short term for a number of reasons. First, building and testing the user models is not a short term effort in itself. Second, it is not clear that this approach can be successfully incorporated into a real time system. Third, there is a current of thought in the TADMUS project that the system should not actively initiate display changes. As a result, the short term effort is to explore approaches in which any changes relating to completely changing a set of data, as opposed to merely updating the current data, must be user initiated.

The problem then becomes one of how to display information in more static displays that can be expected to positively influence user decision making. Part of our approach is to structure the displays such that suggestions are always shown about alternative conclusions. Also, where the RPD tool

We believe that through these kinds of displays the negative effects of cognitive biases will not be completely eliminated, but that such effects can be reduced. Thus, the fact that alternative explanations are always suggested is expected to act as a critic that continually points up possible weaknesses in each possible explanation. The continual display is also intended to reduce the likelihood that the user will focus too quickly on one explanation without giving due consideration to the others. We believe that these kind of techniques can effectually act as a critiquing mechanism to enable users to make decisions more accurately and quickly.

Our work on developing new approaches to real time decision support systems has led to some new ideas about appropriate ways to make use of ideas from work involving critics. Basically, we conclude that what is needed is an interface designed to present data in ways that suggests alternative interpretations, and also highlights possible weaknesses in the interpretations. In this way, a kind of criticism is offered to the user, but the criticism is not direct and is not intrusive.

Hair, D.C., Picksley, K. & Chow, S.. Explanation-Based Decision Support in Real Time Situations, *4th International Conference on Tools With Artificial Intelligence*, pp. 22-25, Arlington, Virginia, 1992.

Klein, G.A.. "Recognition-Primed Decisions," in *Advances in Man Machine Systems Research* 5, pp. 47-92, Rouse, W.R. (ed.), J.A. Press, 1989.

Pennington, N. and Hastie, R.. "Explanation-based Decision Making: The Effects of Memory Structure on Judgment," pp. 521-533, *Journal of Experimental Psychology: Learning, Memory, and Cognition* 14, 1988.

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